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Impacts of oil price shocks on the returns of China's listed oil companies

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Abstract

Based on Structural Vector Auto-regression Model (SVAR), this paper divides global crude oil price shock into oil supply shock, global demand shock, domestic demand shock and precautionary demand shock. It analyzes the impacts of the four types of oil price shocks on the stock returns of China's oil exploitation industry, oil refinery industry and oil sales industry by impulse response function. The sample is from 1, 2008 to 12, 2013. The results show that all the returns of the three industries response to all the four oil price shocks positively, and the impacts of the three demand shocks are most significant. What's more, the returns of different industries response to different oil price shocks differently. The returns of oil exploitation industry is mainly influenced by domestic demand shock, while precautionary demand shock plays the dominant factor of the returns of oil exploitation and oil sales industries. In addition, the more connected with the market, the more significant the impacts of oil price shocks on the returns. Namely, the return of oil sales industry responses to all oil price shocks most significantly, that of oil refinery industry comes second and that of oil exploitation industry comes the last.

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Keywords: oil price shock; China; oil and gas industry; stock return

1. Introduction

It is intuitive that the performance of listed companies in oil industry is closely related to the oil price and the oil price shock could produce bigger influence on the performance. The oil price shock comes from different fields. Generally, it can be decomposed into four types: supply shock, global demand shock, domestic demand shock and precautionary demand shock. The impacts of these shocks may be different. Naturally, the influence of these shocks depends on a country's institutional regime and market. China has

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a transitional economy. There is a big ratio of oil related companies are state owned companies, and the market is not totally merged into the international market. In China, listed oil companies distribute in different sub-industries. In oil exploitation sub-industry, the companies' oil production is the base of domestic crude oil supply. In oil refinery and sales sub-industries, the companies' oil products are related to the domestic economic consumption directly. When the return of oil related companies are affected by oil price shocks, the oil product supply will also be affected to some extent. Then, it's inevitable to affects China's domestic economic development. Therefore, it is vital to know the effects of all kinds of oil prices on the return of oil related companies. In the literatures, there are papers which study the impacts of oil price shocks on the macro economy, but there are few papers about the impacts of oil price shocks on listed companies in oil related industries. Furthermore, there may be some differences in the effects of oil price shocks on listed oil companies operating in different positions of the oil industrial chain. Ignoring these differences will lose some important information. However, it's rarer to find relevant studies in consideration of the differences in different sub-industries. Therefore, this article aims to fill the gap to study impacts of oil price shocks on the stock return of China's listed oil companies in different sub-industries.

The remaining content of the paper is organized as follows. Section 2 is the literature reviews. Section 3 is the brief introduction of the relevant model and data. Section 4 is the empirical results. Section 5 is the robustness check. Section 6 is the main conclusion and the prospect of future research.

2. Literature Review

Relevant studies begin in the researches on the impacts of oil prices change on macroeconomy. Many studies show that oil price shock often causes economic recession and inflation (Darby, 1982; Hamilton, 1996; Hooker, 1999; Barsky and Kilian, 2004). Furthermore, research shows that the impacts of oil price changes on the exporter and importer of crude oil are always different (Jiménez-Rodríguez and Sanchez, 2005).

In the 1990s, Jones and Kaul (1996) show that the oil price shock can affect stock prices by affecting the current or future cash flow or expected earnings. Then, the relationship between the oil market and the stock market research attracts more and more attention, and many researches also confirm the significance of relations between the two markets (Sadorsky, 1999). However, Kilian and Park (2009) believe that the rises in oil price caused by different factors could have even opposite impacts on stock price. What's more, oil price shock not only affects industrial cost directly, but also affects industrial earnings by affecting demand such as buying durable goods (Lee & Ni, 2002). In addition, oil price changes have different impacts on oil and gas companies with different business model (Boyer & Filion, 2007).

Relevant studies about China start from 2000. Du et al. (2010) pointed out that the international oil price affects Chinese economy and inflation in single nonlinear direction. In the aspect of industry, the study shows that oil price shocks have negative impacts on the manufacturing and oil companies after the 2008 financial crisis (Cong et al., 2008). However, there are no studies on the impacts of different oil price shocks on stock returns of China's oil listed companies. Therefore, this paper is intended to investigate different oil price shocks on the stock return of China's listed oil companies in different sub-industries.

3. Methodology

3.1. Analytical framework

This paper aims to examine the impacts of oil price changes on the stock returns of different China's oil sub-industries. First, this paper adopts Shenyin & Wanguo and CITIC industry classification standards. The empirical analysis adopts the former classification standard and the latter is used in robustness check. Second, due to the causes of oil price changes, the study uses SVAR model to decompose the oil price changes into oil supply shock, global demand shock, domestic demand shock and precautionary demand shock. Third, by impulse response function and variance decomposition analysis, the study aims to analyze the impacts of different oil price shocks on the returns of different sub-industries and rank the oil price shocks according to their impacts on returns of different sub-industries. Furthermore, this article also uses return on investment of each industry to replace the stock returns and investigates the differences between the two results. Finally, robustness check tests the above results' stability.

3.2. Data Description

The independent variables are the stock returns of the three sub-industries. Relevant control variables include crude oil production (prod), global economic activity (Activity), and China's domestic demand (IAV) and Global crude oil price (PO). The global economic activity is Drewry's Shipping Monthly. Crude oil production and oil price are available in EIA website, and other data is available Wind Database. Crude oil price is real price adjusted by Sino-US exchange rate and China's domestic CPI. Moreover, global crude oil production, oil prices and the stock returns of oil companies are first difference of original data. China's domestic industrial added value (IAV) is on year-on-year basis. Stock returns are available in Wind database. All variables adopt monthly data. The variables and their source can be seen in Table1.

The unit root test applies ADF, PP and KPSS test. Result shows that Activity and IAV are first-order stationary and the other variables are stationary. Then, the analysis adopts the first-order difference of Activity and IAV. Granger causality test shows oil price change is the Granger cause of the returns of oil exploitation and refinery industries, but not the Granger cause of the returns of oil sales industry. However, this article still introduces the return of oil sales industry to analyze the impacts of oil price changes on it.

3.3. SVAR Model

The general form of structural vector auto regression model is

$$Bx_t = \Gamma_0 + \sum_{i=1}^{n} \Gamma_i x_{t-1} + \varepsilon_t \quad (1)$$

Multiplying the both sides of the equation by B^{-1}, the error vector (e_t) of re-formed VAR model (Equation 2) can be derived. Then, e_t can be decomposed by the residual of the general SVAR model.

$$x_t = A_0 + \sum_{i=1}^{n} A_i x_{t-1} + e_t \quad (2)$$

By SVAR model, oil price shock can be decomposed into oil supply shock, global demand shock, domestic demand shock and precautionary demand shock. First three shocks are due to changes in crude oil production and oil demand. While precautionary demand shock can be explained as a specific oil price shock, it indicates the rise in oil price caused by emergency such as war, civil strife, etc. Error vector can be expressed as the combining form of disturbance terms and structural matrix (see Equation 3). The disturbance terms are oil supply shock, global demand shock, domestic demand shock, precautionary demand shock and residuals of the industries' returns, respectively.

$$e_t = \begin{bmatrix} e_t^{prod} \\ e_t^{Activity} \\ e_t^{IAV} \\ e_t^{po} \\ e_t^{Return1} \\ e_t^{Return2} \\ e_t^{Return3} \end{bmatrix} = \begin{bmatrix} -1 & 0 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 & 0 \\ a_{41} & a_{42} & 0 & 1 & 0 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{oil\ supply} \\ \varepsilon_t^{globaldemand} \\ \varepsilon_t^{domesticdemand} \\ \varepsilon_t^{precautionarydemand} \\ \varepsilon_t^{exploitation} \\ \varepsilon_t^{refinery} \\ \varepsilon_t^{trade} \end{bmatrix} \quad (3)$$

The setting of each parameter in the constraint matrix is based on several bases. (1) Assume that China's oil industries have no impacts on the external, namely $a_{15}=a_{16}=a_{17}= a_{25}= a_{26}= a_{27}= a_{35}= a_{36}=a_{37}=0$; (2) oil producer's adjustment to demand have certain delay and can't response to current demand changes immediately, namely $a_{12}=a_{13}=a_{14}=0$; (3) Although China is the second big economic body, China's economy cannot bring significant changes to the global economy, namely $a_{23}=0$; (4) precautionary demand will increase the oil price, but it doesn't have any impact on the current economic activity, namely $a_{24}=a_{34}=0$; (5) China lacks of pricing power in global oil prices, so assuming that oil price is not affected by China's economy, namely $a_{43}=0$; (6) The companies in upstream have significant impacts on that in downstream, but not vice versa, namely $a_{56}=a_{57}=a_{67}=0$.

4. Results

4.1. Effects of Oil Price Shocks on Industrial Stock Returns

After being imposing a standard deviation of the structural stock on the returns of three sub-industries (oil exploitation, oil refinery and oil sales), the result of impulse response is obtained as shown in Fig.1.

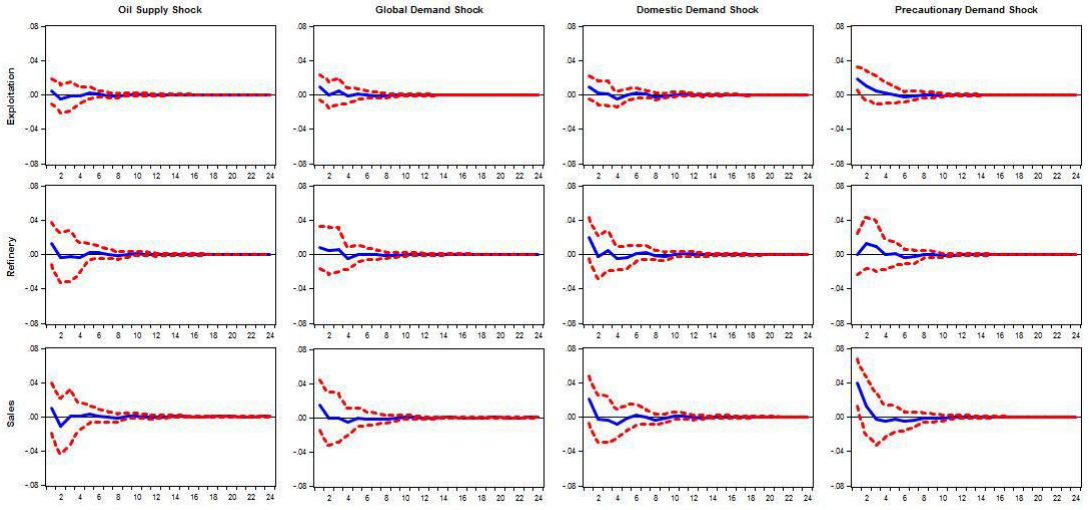

Fig .1. Responses of Exploitation, Refinery and Sales Industry to each Shock

Impulse response results can be summed up in three points: (1) all the returns rise after all the oil price shocks, and the impacts of the demand-side oil price shocks are stronger than that of the supply-side oil price shocks; (2) in the demand-side shocks, the impacts precautionary demand shock is the strongest, and the impacts of domestic demand shock take second place; (3) after oil price shocks, the returns of oil sales industry response strongly most, and the impacts on the returns of oil refinery industry is slightly stronger than that on the returns of oil exploitation industry.

According to the variance decomposition analysis (see Table 2), oil exploitation industry and oil sales industry get consistent results. The returns are mainly affected by precautionary demand shock, followed by domestic demand, global demand shock and oil supply shock. For oil refinery industry, the impacts of domestic demand shock are slightly stronger.

Table 2. Results of Variance Decomposition Analysis

	Oil Supply	Global Demand	Domestic Demand	Precautionary Demand	Exploitation Industry	Refinery Industry	Sales Industry
Exploitation	0.96%	2.06%	2.42%	10.49%	67.49%	13.45%	3.13%
Refinery	1.43%	1.01%	3.08%	1.86%	38.04%	53.26%	1.32%
Sales	1.29%	1.40%	2.87%	10.32%	35.84%	20.07%	28.22%

4.2. Further Analysis

Although the stock price could reflect a company's fundamental information to a certain extent, but the stock price is also dominated by the overall market and the investors' transaction behavior. Therefore, in order to examine the impacts of oil price shocks on the corporate performance, this paper uses all the companies' average ROA and ROE to take the place of the stock returns, and analyzes the difference in the impacts of oil price shocks from the aspects of corporate profitability.

Results show that, in addition to precautionary demand shock, all other oil price shock will increase the companies' ROE. The impacts of domestic demand shock are the strongest. All of these are consistent with the above results. However, the impacts of precautionary demand shock on three industries' ROE are not significant as before. Moreover, there is no huge difference in variance decomposition analysis results, except the precautionary demand shock. It follows that the profitability of China's oil companies is mainly influenced by domestic demand shock. Precautionary demand shock is an indicator of oil availability in the future, and it mainly affects the speculators in the stock market rather than actual corporate profitability. Thus, the dominate factor impacts the returns of China's oil listed companies is the speculators' trading activities in the stock market, although the corporate performance is the basis information of its stock returns.

5. Robustness Check

To test the stability of above results, this article runs the same model again by CITIC industry classification standard. The results show that the impulse response results with CITIC industry classification standard are consistent with the original results. Overall, the dominated oil price shocks are still precautionary demand shock and domestic demand shock. Besides, variance decomposition analysis results show the impacts of precautionary demand shock and domestic demand shock on the returns of three industries are still very significant. Therefore, the results of this article have strong stability.

6. Conclusion

Above studies indicate that the oil price shocks have some impacts on oil industrial returns in common. First, the impacts of oil demand shocks are significantly stronger than that of oil supply shocks. Secondly, all the oil price shocks have positive impacts on the returns of China's oil listed companies. In addition, the impacts of precautionary demand shock are the strongest in all the oil demand shocks. However, there is also difference the impacts oil price shocks on the industrial stock returns. The impacts of oil price shocks on returns get stronger as the industry's tighter connection to the market.

In addition, this paper finds an interesting result that the supply- and demand-side shocks in fundamentals are dominated factors for China's oil companies' performance, while precautionary demand shock is the most important to China's oil companies' returns.

In fact, the oil price shocks not only affect the financial side of the listed oil companies, but in turn affect the oil supply and oil trade of the country. The impacts of oil price shocks on the returns of China's listed oil companies are the overall responses of the listed oil companies to the price shocks. The different responses of three sub-industries reflect how the sub-industries answer the oil price shocks by adjusting their oil production, oil refinery and oil sales, which may produce a significant change of the energy configuration in short term. Moreover, the different responses of three sub-industries also reflect how the investors answer the oil price shocks by changing their position in the market, which will produce a long-term influence on the energy industry.

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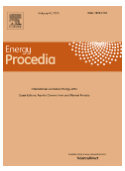

Biography

Xiaoguang Yang is a professor in School of Business Administration of China University of Petroleum-Beijing and a professor in Academy of Mathematics and Systems Science, China's Academy of Sciences. Research fields: financial risk, macroeconomics, and game theory.